LISTING OF CLAIMS

1. (Cancelled)

2. (Withdrawn) The method according to claim 71, wherein a frequency of 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

3. (Withdrawn) The method according to claim 2, wherein the first series resonant frequency f_0 is larger than three times the power frequency f_e.

4. (Withdrawn) The method according to claim 3, wherein a series resonant frequency f_0' which is defined by a capacitance between the plasma excitation electrode and a counter electrode for generating the plasma in cooperation with the plasma excitation electrode, is larger than three times the power frequency f_e.

5. (Withdrawn) The method according to claim 4, wherein the plasma excitation electrode and the counter electrode are of a parallel plate type, and the series resonant frequency f_0' and the power frequency f_e satisfy the relationship:

wherein d represents the distance between the plasma excitation electrode and the counter electrode, and δ represents the sum of the distance between the plasma excitation electrode and the generated plasma and the distance between the counter

$$f_0' > \sqrt{\frac{d}{\delta}}\, f_e$$

electrode and the generated plasma.

6. (Withdrawn) The method according to claim 71, further comprising a resonant frequency measuring terminal for measuring a resonant frequency of the plasma processing chamber, in the vicinity of the end of the radio frequency feeder.

7. (Withdrawn) The method according to claim 6, further comprising a switch provided between the radio frequency feeder and the resonant frequency measuring terminal, wherein the switch electrically disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal and connects the end of the radio frequency feeder to the output end of the matching circuit in a plasma

excitation mode in which the plasma is excited, whereas the switch electrically connects the end of the radio frequency feeder to the resonant frequency measuring terminal and disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal in a measuring mode in which the resonant frequency of the plasma processing chamber is measured.

8. (Withdrawn) The method according to claim 6, further comprising a resonant frequency measuring unit which is detachably connected to the resonant frequency measuring terminal.

9 – 63. (Cancelled)

64. (Withdrawn) The method according to claim 72, wherein the plasma excitation electrode comprises an overlapping area with respect to the chamber wall, the overlapping area adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

65. (Withdrawn) The method according to claim 72, wherein the radio frequency feeder has a length adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

66. (Cancelled)

67. (Withdrawn) The method according to claim 73, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

68. (Withdrawn) The method according to claim 73, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the

chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that the first series resonant frequency f_0 is larger than a power frequency f_e.

69 – 70 (Cancelled)

71. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber having a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radio frequency feeder;

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating a first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more mechanical parameters of the plasma processing chamber during the non-discharge period to modify the first series resonant frequency f_0 so that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder; and

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

72. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber, a counter electrode, and a shower plate, the plasma processing chamber having a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radiofrequency feeder; and

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating a first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more mechanical parameters of the plasma processing chamber during the non-discharge period such that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder;

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

73. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber having a first series resonant frequency f_0 and a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radiofrequency feeder; and

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating the first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant

frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more of a shape of a feed plate, an overlapping area of the plasma excitation electrode and a chamber wall, and the capacitance between a susceptor electrode and a chamber wall such that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder;

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

74. (New) A plasma processing apparatus comprising:

a plasma processing chamber having a plasma excitation electrode for exciting a plasma;

a radio frequency generator for supplying a radio frequency voltage to the electrode;

a radio frequency feeder connected to the electrode;

a matching circuit having an input terminal and an output end, wherein the input terminal is connected to the radio frequency generator and the output end is connected to an end of the radio frequency feeder so as to achieve impedance matching between the plasma processing chamber and the radio frequency generator; and

a set of electrical radio frequency factors of the plasma processing chamber configured such that at an end of the radio frequency feeder a frequency, which is three times a first series resonant frequency f_0 of the plasma processing chamber, is larger than a power frequency f_e of the radio frequency waves at the end of the radio frequency feeder,

wherein the first series resonant frequency f_0 is based on the measured impedance of the path from the radio frequency feeder to the ground via a shaft and

a variable oscillation frequency when the plasma processing chamber is disconnected from the matching circuit , and the first series resonant frequency f_0 corresponds to a minimum impedance of the plasma processing chamber when the plasma chamber is disconnected from the plasma apparatus during a non-discharge period.

75. (New) A plasma processing apparatus according to claim 74, wherein a frequency of 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

76. (New) A plasma processing apparatus according to claim 75, wherein the first series resonant frequency f_0 is larger than three times the power frequency f_e.

77. (New) A plasma processing apparatus according to claim 76, wherein a series resonant frequency f_0' which is defined by a capacitance between the plasma excitation electrode and a counter electrode for generating the plasma in cooperation with the plasma excitation electrode, is larger than three times the power frequency f_e.

78. (New) A plasma processing apparatus according to claim 77, wherein the plasma excitation electrode and the counter electrode are of a parallel plate type, and the series resonant frequency f_0' and the power frequency f_e satisfy the relationship:

wherein d represents the distance between the plasma excitation electrode and the counter electrode, and δ represents the sum of the distance between the

$$f_0' > \sqrt{\frac{d}{\delta}}\, f_e$$

plasma excitation electrode and the generated plasma and the distance between the counter electrode and the generated plasma.

79. (New) A plasma processing apparatus according to claim 74, further comprising a resonant frequency measuring terminal for measuring a resonant frequency of the plasma processing chamber, in the vicinity of the end of the radio frequency feeder.

80. (New) A plasma processing apparatus according to claim 79, further comprising a switch provided between the radio frequency feeder and the resonant frequency measuring terminal, wherein the switch electrically disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal and connects the end of the radio frequency feeder to the output end of the matching circuit in a plasma excitation mode in which the plasma is excited, whereas the switch electrically connects the end of the radio frequency feeder to the resonant frequency measuring terminal and disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal in a measuring mode in which the resonant frequency of the plasma processing chamber is measured.

81. (New) A plasma processing apparatus according to claim 79, further comprising a resonant frequency measuring unit which is detachably connected to the resonant frequency measuring terminal.

82. (New) A plasma processing apparatus comprising:

a plasma processing chamber having a plasma excitation electrode for exciting a plasma, a counter electrode, and a shower plate disposed between the plasma excitation electrode and the counter electrode;

a radio frequency generator for supplying a radio frequency voltage to the plasma excitation electrode;

a radio frequency feeder connected to the plasma excitation electrode; and

a matching circuit having an input terminal and an output end, wherein the input terminal is connected to the radio frequency generator and the output end

is connected to an end of the radio frequency feeder so as to achieve impedance matching between the plasma processing chamber and the radio frequency generator,

wherein a frequency which is three times a first series resonant frequency f_0 of the plasma processing chamber which is measured at the end of the radio frequency feeder is larger than a power frequency f_e of the radio frequency waves, and

wherein the first series resonant frequency f_0 is determined by disconnecting the chamber from the rest of the system so that the chamber is in a non-discharge state and then measuring impedance of the path from the feed plate to the ground via the shaft with an impedance meter while varying the oscillation frequency, the first series resonant frequency f_0 corresponding to a minimum impedance of the plasma processing chamber, the minimum impedance evaluated with the plasma chamber disconnected from the plasma apparatus during a non-discharge period.

83. (New) The plasma processing apparatus according to claim 82, wherein the plasma excitation electrode comprises an overlapping area with respect to the chamber wall, the overlapping area adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

84. (New) The plasma processing apparatus according to claim 82, wherein the radio frequency feeder has a length adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

85. (New) A plasma processing apparatus comprising:

a plasma processing chamber having a first series resonant frequency f_0 and a plasma excitation electrode for exciting a plasma;

a radio frequency generator for supplying a radio frequency voltage to the electrode;

a radio frequency feeder connected to the electrode; and

a matching circuit having an input terminal and an output end, wherein the input terminal is connected to the radio frequency generator and the output end is connected to an end of the radio frequency feeder so as to achieve impedance matching between the plasma processing chamber and the radio frequency generator,

wherein the first series resonant frequency f_0 corresponds to a minimum impedance of the plasma processing chamber, the minimum impedance evaluated with the plasma chamber disconnected from the plasma apparatus during a non-discharge period, and

wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

86. (New) The plasma processing apparatus according to claim 85, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

87. (New) The plasma processing apparatus according to claim 86, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the chamber wall, or the capacitance between a susceptor

electrode and the chamber wall is adjusted such that the first series resonant frequency f_0 is larger than a power frequency f_e.